UME TRENDS: Observing a Decade of Change and Preparing for the Future

I don't really know where UME Trends came from, originally. I just know that in 1987 I got a phone call from Bill Leveque, who was then Executive Director of the American Mathematical Society (AMS). Bill told me about an idea that was going around that there should be some kind of publication specifically focused on mathematics education and that the National Science Foundation (NSF) had indicated a willingness to consider a proposal to fund such a project. Would I be interested, he wanted to know, in working on designing a publication and preparing an NSF proposal which would name me as the Editor?

What happened during the subsequent 9 years relative to mathematics education can be summarized in three words: the culture changed. You might think it is impossible to tell whether the existence of UME Trends was a result of that change, which surely had begun well before Leveque's phone call, or whether it has been a cause of that change. Actually it is easy to tell. UME Trends has been *both* a result of, and an agent for, change in the role of mathematics education within the mathematical community.

At the invitation of Keith Devlin, Editor of FOCUS, I would like to present some personal reflections on this cultural change and say a few things about what I consider important for the future. I think it would be very good to write a history of this period in mathematical life, but I am not an historian. I am not even an especially good keeper of long term records. So I will not try to make this little piece any kind of record of names, dates, places. I will just put down some of my memories about what is was like when Leveque called me, how UME Trends came into being, how it developed in relation to the rest of events regarding mathematics education, and, finally, some of the things I see ahead — rather what I would *like* to see in the near future.

The culture in 1987.

The end of the 1980s was also an end, or completion if you like, of a number of changes in the mathematical culture. Mathematics had experienced a "boom" period of growth in the 1960s, brought on by the nation's reaction to Sputnik, and had gone through more than one cycle of expansion and, if not contraction, at least slow-down. But the overall condition was growth. The number of mathematics departments, Ph.D. programs, and professional mathematicians had increased by orders of magnitude. Statistics, applied mathematics, and computer science had joined theoretical mathematics to form what we now call the Mathematical Sciences. The AMS and MAA had become "democratized", at least to the point of holding contested elections and the content of annual winter and summer meetings expanded beyond invited hour talks and contributed papers.

The change in the annual meetings is important because of what it tells us about the interests of mathematicians and the responses of our professional organizations to those interests. Up

until this point, the overwhelming majority of talks were about new and recent mathematics, or expository presentations of established mathematical content. Although this kind of program was, and is, of major importance to the profession, there was some concern in the 1980s about whether it was all that should be on the program, in terms of the interests of attendees. What is undeniable is that many of the events were very poorly attended, in fact, the overall attendance at these meetings was not as high as desired.

Not everyone felt there was anything amiss in all of this. I remember a conversation I had with one major figure in mathematics in which I pointed out that a large part of the professional activity that took place in our community was of interest and/or benefit to only a very small percentage of, for example, the membership of the AMS. I noted, in that regard, that a recent study had shown that less than 5% of the people who get a Ph.D. in mathematics publish more than one paper. The response was to the effect that this was as it should be. There were people who were doing the really important mathematics — and they were very few in number — and everyone else provided the audience for this mathematics. In return for this service, the overwhelming majority of members of the AMS were granted the privilege of belonging to the prestigous AMS, a fact they could list on their vitas! Incredible as it may seem, I do not think that it has been very long since this view was conventional wisdom in certain mathematical circles.

When the arguments for paying more attention to education made things too uncomfortable, mathematicians generally pointed to the MAA as the organization that was taking care of educational matters. Unfortunately, at that time, the general view among mathematicians was that paying attention to education meant thinking about what courses should be in the curriculum, and what their content should be, together with elegant expositions of interesting mathematics.

Again, as with the emphasis on reports of current mathematics that was the province of the AMS, I want to insist on the importance of paying attention to curricular matters as well as the joy, and therefore importance, of beautiful mathematical expositions. My point is that at this time there was a growing body of opinion that, at least as far as education was concerned, content and exposition were not enough.

The development of UME Trends

There is no question that the major changes in our mathematical culture with respect to education were fueled by the calculus reform movement. Initiated as a response to Tony Ralston's challenge to calculus as the appropriate "first college course" for *all* students, brought forth by the Tulane conference, stimulated by funds from the NSF, and most importantly, carried on by a myriad of mathematicians who really wanted to do something to improve what is a disastrous educational operation, this movement has existed for a decade. It has branched out beyond calculus to other more and less advanced college mathematics courses and been a major agent

for educational change. This is not the place to chronicle the calculus reform movement (see the January, 1995 issue of UME Trends for an extensive treatment). The main relevance to this article is that the existence of UME Trends was seen by many, especially the NSF, as part of this movement.

After Leveque's phone call, I worked with Jim Voytuk, Associate Secretary of the AMS, to organize a small planning meeting which took place at the Chicago airport in October, 1987. Some of the results of this meeting were: a name for a newsletter, a design, and plans for a proposal to NSF. In the next few months, the proposal was written and submitted; in summer 1988 the proposal was funded; in fall of that year a staff was gathered; and, in March 1989, Volume 1, Number 1 of UME Trends appeared.

In the course of producing the NSF proposal, it was decided to make this a joint project of AMS, MAA, and the Society for Industrial and Applied Mathematics (SIAM). This meant that an organization was needed to be the "owner" of UME Trends and the only possibility was the Joint Policy Board for Mathematics (JPBM). This was not the best solution, since JPBM is not really set up to publish a newsletter. It has neither the staff, nor the budget to play this role and although AMS, MAA and SIAM all did more than they had to for UME Trends in the ensuing years, the publication suffered from the lack of an organizational home.

What happened in practice was that, for the first four years, AMS served as the actual publisher and MAA took over for the following three years. Both organizations devoted huge amounts of time, energy, talent, and money. SIAM also made its contribution. What success UME Trends has had owes a great deal to efforts of these organizations.

But the most important role was played by the Department Editors and the Editorial Committee. It was decided early that UME Trends would have a combination of regular departments and single articles. The heads of these departments almost without exception stayed the full seven years and, although the Editorial Committee underwent the normal changes of AMS, MAA, and SIAM committees, there was a considerable measure of continuity. I have always considered this group of about 15 people to make up the UME Trends team and I have relied on them heavily throughout the years. I believe that the quality of the publication is entirely due to their efforts.

The contribution of the UME Trends team was two-fold. First of all, there was a total of 8 departments, some of which appeared in every issue and some of which appeared in every other issue. Together, they made up about one third of the content of the Newsletter. Most of the rest of the space was devoted to individual articles. The UME Trends team met twice a year (at the Winter and Summer meetings). In addition to general discussion of organizational issues, the main business of these meetings was to make a list of articles we should try to get and who might write them. Then, individual members of the team took responsibility for soliciting the articles we decided on. My role was mainly to coordinate all this and provide back up when editors or

authors were delayed or had other difficulties.

I think this proactive role of the Editorial team is relatively unique in publications of the mathematical community and I think that it was one major factor in the success of UME Trends. In response to the ending of UME Trends, MAA is moving to develop alternative forms to serve the purposes of UME Trends (such as publishing UME Trends type material in other publications), I hope that we do not lose this spirit of "going out and getting" good articles about important subjects of current interest.

Which brings us to the demise of UME Trends. In the first years of publication, support from the NSF permitted us to send UME Trends free to all members of the mathematical community (the first year) and those who requested it (the second year) and defrayed some of the other costs of publication for the first three years. The NSF gave additional support for the special issue on Calculus Reform (January, 1995) which was also sent to "everyone". Other than that, the only source of income for UME Trends was subscription fees and an occasional, unsolicited contribution.

The number of paid subscriptions never reached the level (a little over 4000) necessary to make UME Trends self-supporting and the members of JPBM paid the difference. It is certainly the case that low subscriptions and excessive costs were important factors in deciding to cease publication.

But there is another consideration. We can estimate that there are about 40,000 college teachers of mathematics in the US. What does it mean that less than 10% of them have subscribed to UME Trends? One possible answer is insufficient interest in the contents of UME Trends. But there is reason to believe that this may not be so. There are a lot of indications that the set of subscribers to UME Trends is only a small subset of the set of readers. There is a very large number of mathematics departments in which exactly one person subscribes. The Newsletter is found in many department commons rooms. Moreover, our calls for additional subscribers have elicited many expressions of support and, as far as I know, not one single person has expressed the view that the publication is not worth having.

There are many reasons, in these complex, financially difficult times why individuals may not subscribe to a particular publication. The MAA is taking the view that it is important to get the material that appears in UME Trends out to all members of the mathematical community, and not just the few who have chosen to subscribe. To this end, efforts are being mounted to see that the important material that has appeared in UME Trends now be published in the various MAA publications.

Changes that we saw

How has the mathematical culture changed in the past decade with respect to mathematics education? I think there have been two major changes. There has been an overall increase in

interest and activity in mathematics education, and the emphasis has shifted from being entirely concerned with what college mathematics courses should be taught, in what order and with what content, to what pedagogical strategies might be used and how can we learn to use them.

An important part of this change has to do with technology. We have gone from almost total concern with what changes in topics does technology allow (require?) to at least some interest in the different kinds of pedagogy that can be used in incorporating technology.

I can offer two anecdotes about this change. First there was the NSF sponsored conference in San Antonio in October, 1990. It was held to determine what should be the content of the reformed calculus course. It was a turning point because, at the conference, much of the discussion was about pedagogy and no topics list came out of the meeting. On the personal side, I worked with a group at Purdue University to submit, in Fall 1987, a proposal to NSF for a large, multi-year calculus reform project. It was rejected and we even got a letter from NSF saying explicitly that we were not encouraged to revise and submit because our project was too much concerned with pedagogy and research in learning. Nevertheless, we did resubmit, making mainly minor cosmetic changes and the following year, our proposal was funded, giving us almost all the money we asked for. The amount of money was, at that time, the largest amount awarded to a single university for calculus reform. The culture was changing.

I think that UME Trends was one of the agents for that change. Apart from contributing to the overall ambience of interest in education, I believe that the article by Lida Barrett and Bill Browder (UME Trends, October, 1989) was instrumental in convincing people that pedagogy was not being paid enough attention.

The increase in interest and activity is easy to see. All of the professional societies now have councils or committees on education. The AMS and MAA have a Joint Committee on Research in Undergraduate Mathematics Education which, amongst other activities, edits Research in Collegiate Mathematics Education, an annual volume of research papers. The MAA Committee on Professional Development is engaged in developing a number of courses on pedagogy including a course on cooperative learning, a course on pedagogy for graduate students, and a course on how mathematics can be applied. These courses are expected to make heavy use of distance learning techniques. The MAA also has Project CLUME, funded by the NSF, which conducts workshps on cooperative learning. One of the most exciting new activities is Project NExT, funded by the Exxon Educational Foundation, which is a program for young mathematicians, aimed at improving college teaching. Other encouraging developments include the Humanistic Mathematics Network and the MER Department Network.

These changes are reflected in the Winter and Summer meetings of the AMS and MAA. Today the meetings are full of contributed paper sessions (which now average upwards of 80 people in every audience), panels, and even invited hour talks on research in collegiate mathematics

education. In 1994, Steve Monk and in 1995, Joan Ferrini-Mundy spoke to packed houses about this topic.

Again to put a personal note on it, I have been involved since about 1990 in organizing, or helping to organize, at these meetings, a contributed session of papers on research in undergraduate mathematics education. Although the interest in these sessions is always high, and has been increasing, it has become more and more difficult to get this session on the program. In the beginning, the program committee welcomed, almost to the point of soliciting, our request to run this session. Now, we have to wait our turn and we don't get as much time as we want. The reason is that there are now many other programs of equal interest and importance being proposed, and the appropriate commitees have moved from trying to generate programs to deciding which of many excellent suggestions should be accepted!

What the future might bring

So, having participated in these changes, and edited a publication that tried to report on all of them, I perhaps can take for myself the liberty of saying what I think are the most important changes for the future. It is not so much a prediction as a call. Or, if you prefer, I am simply laying out what will be my personal agenda for progress in the coming years.

The first thing is to continue reporting on education matters. Now that UME Trends is no longer part of the scene, the MAA is making a major effort to increase the number of education articles that appear in MAA publications. The editors of these publications have expressed their interest in publishing good articles about education and various policies that inhibited this have been revoked. More directly, the MAA has appointed the Committee on Publishing Educational Material (COPEM) which is charged with working with editors and potential authors to increase the quantity and quality of material that is submitted, to help editors plan for receiving educational material and to help authors see what kinds of material might be most interesting and informative for readers.

Next, I want to emphasize the need to concentrate our attention on pedagogy. I think that college faculty must become more reflective about how their students learn and what pedagogical strategies will be most helpful to the process. Concurrently, departments need to allocate resources (including positions) to curriculum development and educational research so all faculty can see that it "counts" and none will be tempted to say, "Education is what you do when you can't do math."

One major step in developing our pedagogy is research in learning and teaching. Of course we must study how we teach and what are the effects of our teaching. But we also need to find out a great deal about the learning process. What, exactly, is going on in the minds of our students as they struggle to understand mathematical concepts, to solve problems? Just why is it that some students will have certain kinds of difficulties that others will avoid? Can we focus our teaching

on the elimination of these difficulties? Can we get into the minds of our students and make big changes in how successful they are in mathematics? I think we can and I think that research in learning is a major key to doing that. I want to emphasize that I mean *both* research that will tell us what we might do very soon, and also basic research that may not tell us anything now but contributes to building a foundation for *our* understanding the nature of mathematical knowledge and how individuals do or do not develop it.

And finally, we must do a lot of work with the pedagogical approaches that have the potential to be helpful. There are major strategies such as cooperative learning, the use of computers and calculators, large projects, writing, and distance learning. We have to learn how to use these methods and how to disseminate that knowledge throughout the profession.

In addition to the major strategies, there is a myriad of ideas for specific pedagogical techniques. The regular column *Innovative Teaching Exchange*, edited for 7 years by Bonnie Gold in UME Trends produced nearly 100 short pieces on one or more such methods. We need an outlet to continue publishing these suggestions — and we need a way of getting people to try them out, so that we can discuss their merits.

In conclusion

All in all, it is a wonderful time to be a mathematician interested in education. We have just gone through a decade of growth and all indications are that this is only the begininng. I look forward to more decades in which I will be able to observe and participate in a continued program of pedagogical improvement from the point of view of theory and practice. And the beneficiaries of all this exciting activity are our students, who, according to my experience, are capable of rising joyfully to challenges we set before them and which we convince them are worthy of their greatest efforts.

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